Claims:

1. A printed circuit board element (1) including at least one optical waveguide (6) provided in an optical layer (3) and at least one optoelectronic component (4, 5; 4', 5') in optical connection with the optical waveguide (6), characterized in that the optoelectronic component (4, 5; 4', 5') is embedded in the optical layer (3), that the optical waveguide (6) adjoins the optoelectronic component (4, 5; 4', 5'), and that the optical waveguide is structured by irradiation within the optical layer (3).

2. The printed circuit board element according to claim 1, characterized in that the optoelectronic component (4, 5; 4', 5') with one side borders upon a substrate (2) carrying the optical layer (3), or a cladding layer (3'; 21) applied thereon, respectively.

3. The printed circuit board element according to claim 1 or 2, characterized in that the optoelectronic component (4, 5; 4', 5') is on all sides embedded in the optical layer (3, 3') formed, for instance, by two plies.

4. The printed circuit board element according to claim 3, characterized in that the optical layer (3, 3') is realized as a flexible layer.

5. The printed circuit board element according to any one of claims 1 to 4, characterized in that at least two optoelectronic components (4, 5; 4', 5') connected with each other via the optical waveguide (6) are embedded in the optical layer (3).

6. The printed circuit board element according to any one of claims 1 to 5, characterized in that the, or at least one, optoelectronic component(s) borders upon a heat-dissipation layer (21') by one side.

7. The printed circuit board element according to claim 6, characterized in that the heat dissipation layer (21') is formed by a patterned inner ply.

8. The printed circuit board element according to any one of claims 1 to 7, characterized in that the optoelectronic component (5) is combined with an associated electronic component (14) to an embedded unit (514).

9. The printed circuit board element according to claim 8, characterized in that the embedded unit (514) is an optoelectronic chip.

10. The printed circuit board element according to any one of claims 1 to 9, characterized in that the optoelectronic component (4, 5) borders upon an electrically conductive distribution layer (21').

11. The printed circuit board element according to claim 10, characterized in that the distribution layer (21') is connected with at least one external electrical contact.

12. The printed circuit board element according to claim 11, characterized in that the distribution layer (21') is connected with the at least one external electrical contact through a via (22) provided in the substrate (7').

13. The printed circuit board element according to any one of claims 1 to 12, characterized in that a printed circuit board layer (7, 7') having a patterned, conductive inner ply (21, 21') and/or outer ply (9, 9') is applied on at least one side of the electrically insulating optical layer (3).

14. The printed circuit board element according to any one of claims 1 to 13, characterized in that the optoelectronic component (4, 5), or optionally the unit (514), is contacted through vias (10) provided in the optical layer (3) as well as, optionally, in a printed circuit board layer (7) applied on the same.

15. The printed circuit board element according to claim 14, characterized in that an electronic component (13, 14) connected with the optoelectronic component (4, 5) is mounted to the printed circuit board layer (7).

16. The printed circuit board element according to any one of claims 1 to 15, characterized in that the optoelectronic component (4', 5') is a component produced *in situ* by thin-film technique.

17. The printed circuit board element according to any one of claims 1 to 15, characterized in that the optoelectronic component is a VCSEL component (34) to which the optical waveguide adjoins, e.g. with an arc-shaped transition (33').

18. The printed circuit board element according to any one of claims 1 to 17, characterized in that the optoelectronic component (6) is widened in a funnel-shaped manner on its end (34) adjacent the optoelectronic component (4).

19. The printed circuit board element according to any one of claims 1 to 17, characterized in that the optical waveguide (6) at least partially encloses the optoelectronic component (4) on its end (37; 39) adjacent the optoelectronic component (4).

20. The printed circuit board element according to any one of claims 1 to 17, characterized in that the optical waveguide (6) is provided with a photonic light-diffractive crystal structure (38) on its end adjacent the optoelectronic component (4).

21. The method for producing a printed circuit board element (1) according to any one of claims 1 to 20, characterized in that at least one optoelectronic component (4, 5; 4', 5') is mounted to a substrate (2), that an optical layer (3) comprised of an optical material changing its refractive index under photon irradiation is subsequently applied to the substrate while embedding the optoelectronic component (4, 5; 4', 5') in the optical layer (3), and that, thereafter, a waveguide structure (6) adjoining the optoelectronic component (4, 5; 4', 5') is produced in the optical layer (3) by photon irradiation.

22. The method according to claim 21, characterized in that at least two optoelectronic components (4, 5; 4', 5') are mounted to the substrate (2) and embedded in the optical layer (3) and

thereafter are connected with each another by the optical waveguide (6) directly adjoining the same.

23. The method according to claim 21 or 22, characterized in that, after the production of the optical waveguide structure (6) in the optical layer (3), a printed circuit board layer (7, 7') including a conductive inner ply (21, 21') and/or outer ply (9, 9') is applied to at least one side of said optical layer (3).

24. The method according to claim 23, characterized in that the inner ply (21, 21') is patterned before applying the printed circuit board layer to the optical layer.

25. The method according to claim 23 or 24, characterized in that the outer ply (9, 9') is patterned after the application of the printed circuit board layer to the optical layer.

26. The method according to any one of claims 23 to 25, characterized in that vias (22) are provided in the optical layer (3), optionally also in the printed circuit board layer (7, 7'), in coordination with the respective optoelectronic component (4, 5; 4', 5') and that electrically conductive connections to the optoelectronic component are established through said vias.

27. The method according to claim 26, characterized in that at least one electronic component (13, 14), which is conductively connected with the optoelectronic component (4, 5), is mounted to the printed circuit board layer (7) and/or the substrate.

28. The method according to any one of claims 21 to 27, characterized in that an optoelectronic component (5) combined to a unit with an associated electronic component (14) is mounted to the substrate and embedded in the optical layer.

29. The method according to any one of claims 21 to 28, characterized in that the substrate (3) is provided with at least one cladding layer (3'; 21) before applying the optoelectronic component (4, 5) thereto.

30. The method according to claim 29, characterized in that a cladding layer (3') of optical material is applied to the substrate (3).

31. A method according to claims 29 or 30, characterized in that an electrically conductive cladding layer (21') is applied to the substrate as a distribution layer, said distribution layer being subsequently patterned, if required.

32. The method according to claim 31, characterized in that electrical connections for the optoelectronic component (4, 5) are established throughout the distribution layer.

33. The method according to claim 31 or 32, characterized in that the distribution layer is configured as a heat-dissipation layer.

34. The method according to any one of claims 21 to 33, characterized in that the optoelectronic component (4, 5) is produced *in situ* on the substrate (3) by thin-film technique.

35. The method according to any one of claims 21 to 34, characterized in that the optical waveguide structure (6) is produced with a funnel-shaped widening (37) on its end adjacent the optoelectronic component (4).

36. The method according to any one of claims 21 to 34, characterized in that the optical waveguide structure (6) is produced with an end region (37; 39) at least partially enclosing the optoelectronic component (4).

37. The method according to any one of claims 21 to 34, characterized in that the optical waveguide structure (6) is produced with a photonic light-diffractive crystal structure (38) on its end adjacent the optoelectronic component (4).

Summary

Disclosed is a printed circuit board element comprising an optical waveguide and an embedded optoelectronic element.